

## Leech repellents used by Estate workers in O' valley Panchayat of Nilgiri Biosphere Reserve

P Dhottamma<sup>a</sup>, J Ebanasar<sup>a\*</sup> & B D Sheeja<sup>b</sup>

<sup>a</sup>Department of Zoology, Government Arts College, Udthagamandalam-643002, Tamil Nadu 643 002

<sup>a</sup>Government Arts and Science College, Modakkurichi, Erode District, Tamil Nadu 638 104

<sup>b</sup>Department of Botany, Government Arts College, Udthagamandalam-643002, Tamil Nadu 643 002

\*E-mail: ebanasar@gmail.com

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A field study was conducted among estate workers of different types of plantations viz., cardamom, tea, clove, pepper and coffee where leech bite is common for humans and cattles in forest and estates. Plant-based products as leech repellents are used and applied by estate workers of O'valley Panchayat of Gudalur taluk in Nilgiris. The plant species used are enlisted. Estate workers as informants were interviewed with questionnaire group discussion. The data were analyzed using different statistical quantitative tools viz., use value (UV), frequency citation (FC), fidelity level (FI %) and factor informant consensus (FIC). The data obtained revealed use of seven medicinal plants as effective leech repellents. The species identified are- *Oxalis latifolia* L., *Ageratum conizoides* L., *Nicotiana tobacum* L., *Piper betle* L., *Tithonia diversifolia* (Hemslay), *Cucumis prophetarum* L. and *Brugmansia suaveolens* (Bercht).

**Keywords:** Fidelity level, Frequency citation, Factor informant consensus, Herbal, Leech repellent, O valley, Plantations, Traditional knowledge, Use-value

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Traditional medicines are playing significant role in the health of human beings and livestock. Leeches are predatory blood sucking annelids that feed on the blood of other animals including human. These are "Hematophagous". Leeches have strong anterior and posterior suckers. The anterior suckers surround the mouth which contains teeth, used for biting and sucking blood from the host<sup>1</sup>. Most of the terrestrial leeches are found in tropical and subtropical areas<sup>2</sup>. Saliva of leech contains types of active compounds, including an anticoagulant hirudin. Most of the component compounds are proteins and peptides which prevent blood clotting and coagulation of host blood at the site of leech bite<sup>3</sup>. In India, 51 species and 8 sub species of leeches are prevalent<sup>4</sup>. Leeches suck 5-15 mL of blood during an attachment period lasting for 20-40 min. Now-a-days people are using herbal based repellents which are safer and non-hazardous. Plants also comprise the largest component of the diverse therapeutic elements for traditional livestock health care practices<sup>5</sup>. Numerous studies are reported on the effect of repellents on

mosquitos but only few are reported as leech repellents. Traditionally various types of substances are used to repel leeches. These include, plant extracts, aromatic oils and non herbal products. Land leeches are usually found inactive during monsoon seasons with heavy rain fall and during dry and hot weather while are active during slight drizzle<sup>6</sup>. The plantations workers use local medicinal plants to avoid leech bite. These are used to repel and kill leech from the site of the area. The present study deals with medicinal knowledge about herbal methods used as repellents and investigated among workers working in different estates.

### Materials and Methods

#### Study area

The present study was carried out in O'valley Village. O'valley is the town Panchayat in the Gudalur Taluk of The Nilgiris of Tamilnadu. The area is located on 11° 7'19"N longitude and 76° 28'79"E (Fig. 1). As per the data of 2011 census, the population of the present study area is 21943 sq km. This place is surrounded by beautiful mountains, streams and waterfalls. It is located 53 km from

\*Corresponding author

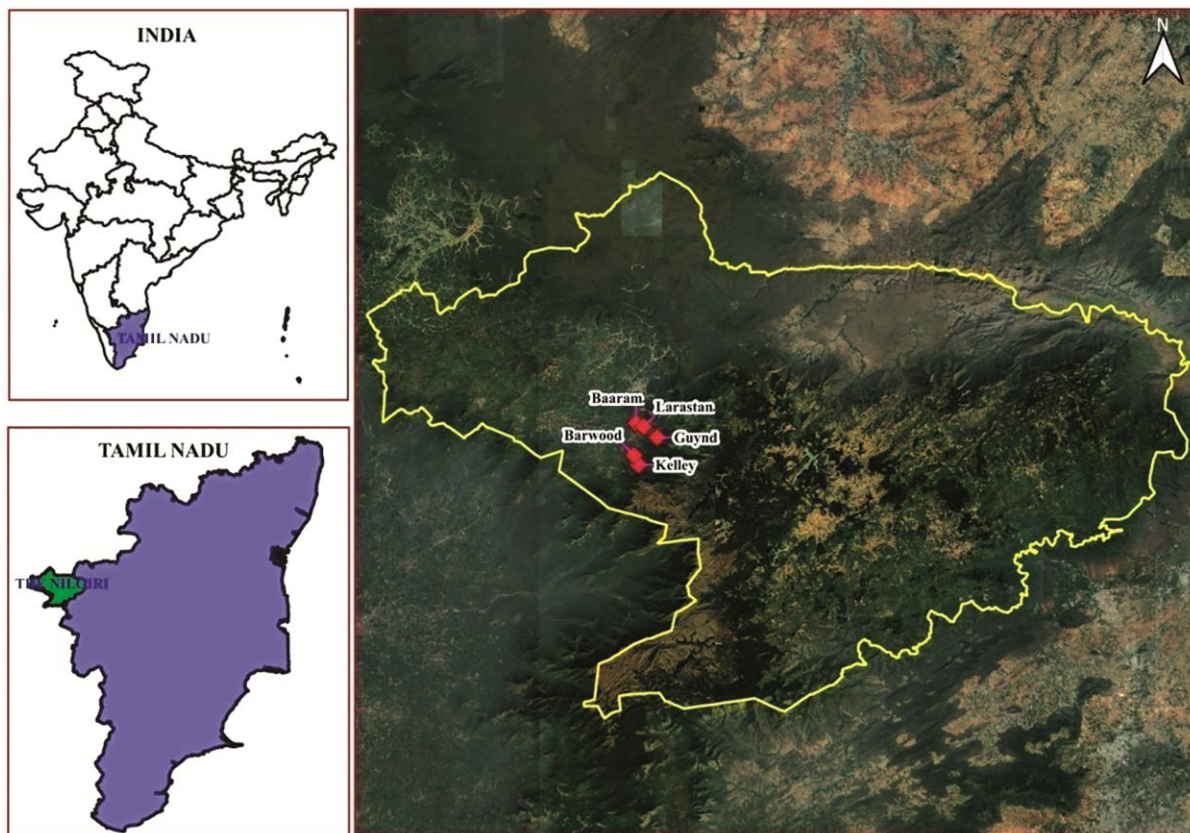


Fig. 1 — Location of study area map

Udhagamandalam. The O'valley consists of different habitat types *viz.*, evergreen forest, grassland forest and plantations, and is divided into 17 divisions.

About 78% humidity is found in O'valley region throughout the year. The small hills of the O'valley are fully covered by plantations like tea, coffee, clove, cardamom and pepper. People residing in this locality are closely associated with forest areas for their livelihood. The plantation workers use locally available medicinal plants to avoid leech bite. It is used to repel and kill leech from the site of the bite area.

In the present study, five estates and five plantations were selected namely, Guynd (Cardamom), Barwood (Coffee), Kelley (Tea), Larastan (Pepper), and Barram (Clove). These five estates receive heavy rain fall during the month of June to August.

#### **Ethnobotanical survey and data collection**

A survey was conducted during June to August month during the abundant availability of leeches in the above said areas and selected people were interviewed. The information was gathered from

estate workers. The selected five estate workers were highly affected by leech bite and traditionally they prepared plant based treatment to cure leech bite. Ethno botanical survey methods which include group discussion and also semi-structured interview were followed<sup>7-8</sup>. A total number of 160 informants working in five estates (66 males and 94 females) were randomly selected and interviewed after obtaining prior informed consent from each respondent. Out of five estates the medicinal plant knowledge informants were selected. Each estate was visited 2-3 times (weekly field trips) and interviewed both men and women of age group varying from 30 to 70 years. While conducting field survey prior permission was obtained from the head of the estate manager and supervisors. A questionnaire was prepared and distributed to workers of each estate. After that all workers were given awareness about the present investigations and its uses. Information was collected from the selected estate informants, about the local names of the plants, parts used, mode of plant preparation and data was recorded carefully. Pictures of the plant species were documented using digital

camera. From this data anti-leech plants were also recorded. The questionnaire method followed through face to face interviews. The following questions covered key issues like (i) informant name (ii) gender (iii) age (iv) residence place (v) plant parts used (flower, whole plant, leaves, roots etc) against leech bite (vi) how to prepare the plant parts for leech control (vii) plants used for healing wounds of leech bite (viii) people or domestic animals were bitten by leeches and (ix) plants used for killing leeches.

#### Plant collection, identification & preservation

All the medicinal plants used by the participants of the survey were collected from O' Valley region and brought to laboratory, and herbarium was prepared using standard procedures. The collected specimens and photos taken in the field were for identification. The voucher specimens were examined to determine the species and botanical name and family done by Flora of Presidency of Madras by Gamble<sup>9</sup>, Flora of the Tamil Nadu Carnatic by Matthew<sup>10</sup>, Manual of cultivated plants by Bailey<sup>11</sup> and Flora of British India by Hokker<sup>12</sup>. The herbarium sheets were submitted to the Department of Botany, Government Arts College, Udthagamandalam for identification and confirmation. The plant parts used by the informants, and mode of application and actions disclosed by informants were documented in the field notes.

#### Data analysis

The data collected from the informants were analyzed by four different indices *viz.*, Use value (UV), Fidelity level (FL %), Factor informant consensus (FIC) and Frequency citation (FC), respectively.

#### Use value

Use value was used to determine the importance of the plant species locally as mentioned elsewhere<sup>13</sup>.

$$UV = \sum U/n$$

Where,

UV is the acronym of use value of the plant species. U = the number of plant cited by each informant for a given species and n = the total number of informants. The UV data was analyzed by one way ANOVA using MINITAB software. When Use value is high plant is considered as important species. If use value move toward to zero (0) it can be inferred that the plant is not much important.

#### Fidelity level

The fidelity index reveals the most significant and preferential plant species used to cure particular ailment<sup>14</sup>.

$$FI (\%) = Np/N \times 100$$

Where,

Np is the numeral value of use reports cited for a given plant species for any ailment category and N is the total number of use reports cited for any given species. FI value (100%) is obtained for plants for which all the informants cite same method using it. Whereas minimum FI value is found for plants that are used for different purposes by the informants<sup>15,16</sup>.

The factor informant consensus (Fic) was used to find homogeneity regarding the practice of the ethno-medicinal plants between the informants<sup>17</sup>. The Fic was calculated as under

$$Fic = (Nur - Nt) / (Nur - 1)$$

Here,

Nur is the number of utility information for particular use category and Nt is the numeral value of species used for particular use category by all informants.

FC = (Number of times a particular species was mentioned by traditional healers/a total number of occasions that all species were mentioned) × 100

## Results and Discussion

#### Informant's demographic data

During the fieldwork, a total of 160 informants (66 males and 94 females) were interviewed (Table 1). The ages of the estate people interviewed were between 30 to 70 years. (Table 2). It was noted that informants with age above 45 or above were more familiar about plants used for medicine. It was observed that the informants between 50-70 of years of age were mostly illiterate. Furthermore, it was well-known that females had more ethno medicinal knowledge than males. Previously it was reported that

Table 1 — Details of the study area

| Estates & Plantation Names                 | Male | Female |
|--|------|--------|
| Guynd (Cardamom)                           | 12   | 18     |
| Barwood (Coffee)                           | 13   | 21     |
| Kelley (Tea)                               | 20   | 28     |
| Larastan (Pepper)                          | 10   | 14     |
| Barram (Clove)                             | 11   | 13     |
| No. of Informants Interviewed (Gender via) |      |        |

Table 2 — Details of the five estate workers (Age group)

| Age Group    | No. of informants |
|--------------|-------------------|
| 30-40        | 82                |
| 41-49        | 45                |
| 50 and above | 33                |
| Total        | 160               |

Table 3 — Plants used for management of leech bite by the estate workers of the study area

| Botanical Name/ Family  | Local name       | Part used      | Traditional uses                                     |
|---|------------------|----------------|--|
| <i>Ageratum conyzoides</i> L. Asteraceae                            | Pumpillu         | Leaf           | Leech repellent & Wound healing from leech bite site |
| <i>Brugmansia Suaveolens</i> (Bercht & J, presl ex Wild) Solanaceae | Oomathai         | Whole plant    | Leech repellent                                      |
| <i>Cucumis prophetarum</i> L. cucurbitaceae                         | Aatru kaai       | Fruit and leaf | Leech repellent & Kill the leech                     |
| <i>Nicotiana tabacum</i> L. Solanaceae                              | Pogai elai       | Leaf           | Leech repellent & Kill the leech                     |
| <i>Oxalis latifolia</i> L. Oxalidacea                               | Pullichai keerai | Leaf           | Leech Repellent                                      |
| <i>Piper betle</i> L. Piperaceae                                    | Vettilai         | Leaf           | Leech Repellent & Wound healing from leech bite site |
| <i>Tithonia diversifolia</i> (Hemslay) A. Gray) Asteraceae          | Kasapu elai      | Leaf           | Leech Repellent & Wound healing from leech bite site |

elderly people of any society have high traditional knowledge due to their tremendous experiences<sup>18-20</sup>.

Seven leech repellent plants were recorded and categorized into three categories. They are repellent, killing agent and used for wound healing. The descriptions of plants are given in (Table 3).

#### Plants used as leech repellent

*Oxalis latifolia* L. (Kunth) (Family: Oxalidacea) is a sour tasting foliage (due to oxalic acid) commonly found in cardamom estates. It is a tropical origin species which can grow and survive well outside the tropics as well. *O. latifolia* L. species are widely distributed in tea, coffee and small-seeded crops<sup>21</sup>. *Oxalis* can provide some relief in urinary tract infections and skin infections. The whole plant is crushed with palms and the sap is applied on the exposed part of the hands and legs for repelling the leech. The workers preferred this plant than the other plants before entering the cardamom and coffee estates.

All estate workers use the leaves of *Ageratum conyzoides* L. to heal the wounds caused and arrest bleeding caused by leech bite. It contains phytochemical such as terpenoids, sterols, flavonoids, chromenes, pyrrolizidine alkaloids, coumarins, pyrrolons, and lignins. *A. conyzoides* L. has rapid and efficient action in burn wounds and irritation part. Brazilian Drugs Centre has recommended it as an antirheumatic<sup>22</sup>. A previous study on *A. conyzoides* L. suggested its common use in curing wounds and burns<sup>23</sup>. The plant foliage is trampled and its extract is applied on the leech bite area which results in quick healing. Similar results were recorded from the Bangni tribe of East Kameng District of Arunachal Pradesh which uses the leaves of *Ageratum*. in order to get relief from terrestrial leech bite<sup>24</sup>. The Apatani tribe of Arunachal Pradesh also uses this plant for rapid wound healing and to stop bleeding due to leech bite<sup>25</sup>.

*Nicotiana tabacum* L. (Family: Solanaceae) is an annually grown herbaceous plant. Its leaves are commercially grown in many countries. All estate workers are using the extract of tobacco. For this the dried *Nicotiana* leaves are powdered and mixed with pinch of salt and soaked with cooking oil for overnight. This mixture is applied on the legs. The leeches were killed easily. Dried leaves are spotted on the skin where the leech has attached strongly. This paralyses the leech it detaches from the body surface. It is more effective and it will kill the leech in few minutes. People of the Kani tribe in Kalakad Mundanthurai Tiger Reserve, South India, a mixture of fruit powder of *Solanum erianthum* L. and *N. tabacum* L. is applied on their legs before going to forest area to protect themselves from leech bite<sup>26</sup>. In addition the other tribal people inhabiting in and around the O'valley viz., *Irular*, *Kurumbar* and *Paniyas* of Nilgiri hills also used these plants as leech repellent.

The leaves of *Piper betle* L. (Family: Piperaceae) have an aromatic flavor. This plant is strong and powerful antiseptic. Application is similar to that of *A. conyzoides* L. Previous studies have shown *Piper betle* L. plant as leech bite repellent<sup>27</sup>. However the present study shows that it can also be used for healing the leech bite wounds.

*Tithonia diversifolia* (Hemslay) A.Gray) (Family: Asteraceae) has been traditionally used as repellent and pesticide against hematophagus parasites like leeches, mites, lice and bedbugs due to the bitter taste of the plant leaves<sup>28</sup>. The plant juice is applied dermally for the fast curative effect and to avoid further secondary infection.

*Cucumis prophetarum* L. (Naud) (Family: Cucurbitaceae) plants are used as traditional medicine during child birth helping remove the placenta quickly and against rabies<sup>29</sup>. Similar results were observed for *C. prophetarum* L. fruits that exhibit antidiabetic and

antioxidant activity<sup>30</sup>. Either leaves or the whole fruit is used to kills and discharge the leech from the body.

*Brugmansia suaveolens* (Bercht & J, presl ex Wild) (Family: Solanaceae) leaves are used in ethnomedicine to alleviate ulcers and fungal infection of the skin<sup>31</sup>. This particular species is native to tropical world. It contains tropane alkaloids such as scopolamine and atropine which are principle components of this plant. In ayurveda the plant leaves are used to cure asthma by burning the leaves and inhaling it. The leaves are trampled and applied on hands and legs by the all agricultural estate workers to avoid leech bite.

The estate workers use plant based practices against the leeches which include deterrent for biting, killing and also for wound healing. The present study showed that plant extract of *O. latifolia* L. is used for repelling leech and *A. conyzoides* L. is used for wound healing. All the estate workers used the *N. tabacum* L. for leech killing.

#### Use value

In the present study, the use value of different plant species for leech repellency differ significantly ( $p < 0.05$ ). The use value of different plants is in the following order:

*O. latifolia* L. > *A. conyzoides* L. > *N. tabacum* L. > *P. betle* L. > *T. diversifolia* (hemsley) > *C. prophetarum* L., *B. suaveolens* (wild Bercht).

#### Fidelity level

Plants used by different estate workers against leech bite is given in Table-4 *viz.*, Fidelity level ranged from FI=4.4 to 100% for *O. latifolia* L., *N. tabacum* L., *C. prophetarum* L. and *B. suaveolens* (wild Bercht). *Agaratum. conyzoides* L. with FI=28.2, *Piper betle* L., with FI=13.7 and *Tithonia. diversifolia* (hemsley) with FI=25.4 were used as wound healing. *Nicotiana tabacum* L. with FI=60.4 and *Cucumis prophetarum* L. with FI= 8.0 were used as killing agent.

#### Factor informant consensus (Fic)

The factor consensus were classified in to three categories (Table 5) *viz.*, repellency, wound healing and killing agent. All the seven plant species reported were used as repellents against leech bite (Fic=0.97). *A. conyzoides* L., *P. betle* L., and *T. diversifolia* (hemsley) were used for treat leech wound healing (Fic=0.98). *N. tabacum* L. and *C. prophetarum* L. were used as leech killing agent (Fic=0.99).

Table 4 — Fidelity level (FI%) of plants for used by different estate workers against leech bite

| Aliment       | Plant species                                   | FI level |
|---------------|---|----------|
| Repellency    | <i>Oxalis latifolia</i> L.                      | 100      |
|               | <i>Ageratum conyzoides</i> L.                   | 4.4      |
|               | <i>Nicotiana tabacum</i> L.                     | 100      |
|               | <i>Piper betle</i> L.                           | 7.6      |
|               | <i>Tithonia diversifolia</i> (Hemsley) A. Gray) | 28.2     |
|               | <i>Cucumis prophetarum</i> L.                   | 100      |
|               | <i>Brugmansia suaveolens</i> (Berch & J, presl) | 100      |
| Wound healing | <i>Ageratum conyzoides</i> L.                   | 28.2     |
|               | <i>Piper betel</i> L.                           | 13.7     |
|               | <i>Tithonia diversifolia</i> (Hemsley)          | 25.4     |
| Killing agent | <i>Nicotiana tabacum</i> L.                     | 60.4     |
|               | <i>Cucumis prophetarum</i> L.                   | 8.0      |

Table 5 — Factor informant consensus (Fic) ethnomedicines used against leech bite estate workers

| Ethnomedicines used against leech bite by estate workers | No of Plant species (Nur) | Use Citations (N) | Fic  |
|--|---------------------------|-------------------|------|
| Repellency   | 7                         | 248               | 0.97 |
| Wound healing  | 3                         | 130               | 0.98 |
| Killing agent  | 2                         | 160               | 0.99 |

Frequency citation of *Oxalis latifolia* against leech bite by workers of different estates

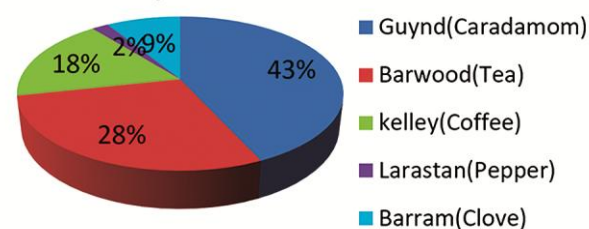


Fig. 2 — Frequency citation (FC) of *Oxalis latifolia*

Frequency citation of *Ageratum conyzoides* against leech bite by workers of different estates

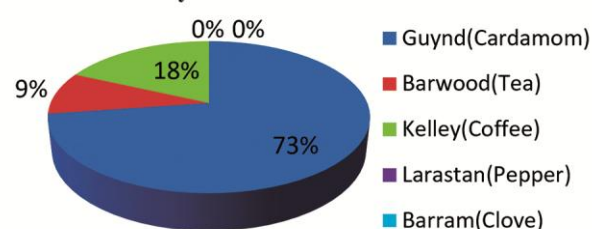


Fig. 3 — Frequency citation (FC) of *Ageratum conyzoides*

#### Frequency of citation

Frequency citation value (Fig. 2) of *O. latifolia* L. (Kunth) was high in Guynd Estate with cardamom plantation (43%) and least value was reported in Larastan Estate with pepper plantation (2%). *A. conyzoides* L. (Fig. 3) frequency of citation was high

**Frequency citation of *Nicotiana tabacum* against leech bite by workers of different estates**

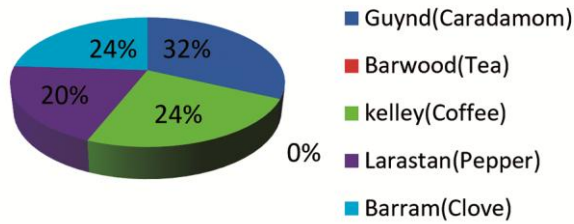


Fig. 4 — Frequency citation (FC) of *Nicotiana tabacum*

**Frequency citation of *Piper betel* against leech bite by workers of different estates**

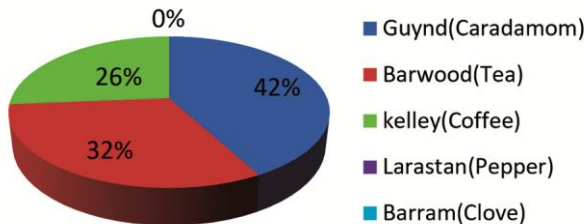


Fig. 5 — Frequency citation (FC) of *Piper betel*

**Frequency citation of *Tithonia diversifolia* against leech bite by workers of different estates**

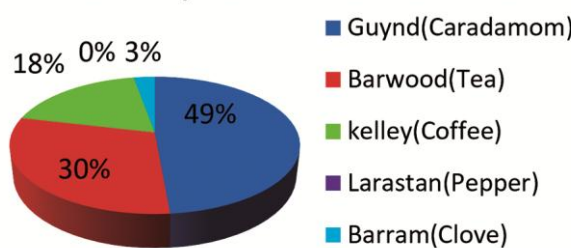


Fig. 6 — Frequency citation (FC) of *Tithonia diversifolia*

**Frequency citation of *Cucumis prophetarum* against leech bite by workers of different estates**

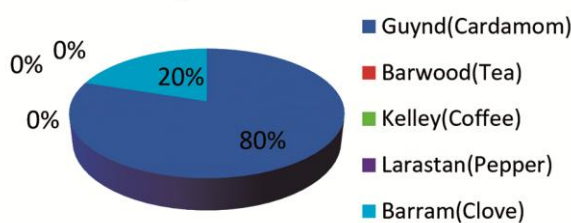


Fig. 7 — Frequency citation (FC) of *Cucumis prophetarum*

in Guynd Estate with (73%) and low value in Larastan Estate (0%). *N. tabacum* L. (Fig. 4) reported high value in Guynd Estate (32%) and low value in Barwood Estate with tea plantation (0%). *P. betel* L. (Fig. 5) high frequency of citation (42%) in Guynd Estate and low

**Frequency citation of *Brugmansia suaveolens* against leech bite by workers of different estates**

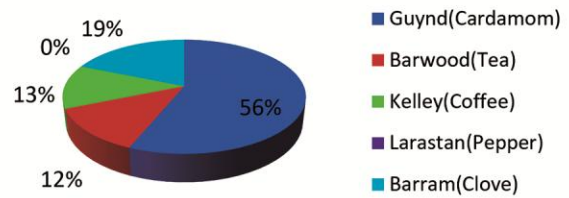


Fig. 8 — Frequency citation (FC) of *Brugmansia suaveolens*

value (0%) in Barram (clove plantation). *T. diversifolia* (hemsley) (Fig. 6) high citation in Guynd Estate (48%) and low value in Larastan Estate (0%). *C. prophetarum* L. (Fig. 7) had high value in Guynd Estate (80%) and low value was reported in Larastan Estate (0%). *B. Suaveolens* (wild Bercht) (Fig. 8) had high citation in Guynd Estate (56%) and low value was reported in Larastan Estate (0%).

**Conclusion**

Traditional herbal medicinal plants are trusted and most popular in this study area. Our report on the use of *Oxalis latifolia* L. and *Cucumis prophetarum* L. as leech repellents and killing is new addition. These plant species can be less expensive, ecofriendly natural plant based repellents available to estates people in this area. These plants are also commonly available for ecotourism and other visitors of this area can effectively use these plants to save themselves from leech bite.

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**Conflict of Interest**

The authors declare that they do not have any conflict of interest.

**Authors' Contributions**

The field work was conducted by PD. The main statistical analyses were performed by PD and JE and BDS edited the manuscript and identified the species. PD and JE wrote the manuscript. All authors are corrected and approved the manuscript.

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